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TOWARDS SUCCESSFUL TRANSFORMATION INTO K-ECONOMY: ASSESSING THE EVOLUTION AND CONTRIBUTIONS OF TECHNO-SCIENCE PARKS IN MALAYSIA

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ABSTRACT

The development of techno-science parks is indeed a wide spread phenomenon in today's technology-inspired era. This concept and all issues related to its development assume increasing importance given the fact that it has unique potentials in accelerating the growth of nation's economy and competitiveness. In order to succeed in today's knowledge economy and to realize its vision of becoming a developed nation by the year 2020, it must develop the requisite infrastructure and infostructure which are needed to support knowledge-based industries as well as activities related to such economy. One of the strategic tools for the successful transformation into knowledge economy is the development of techno-science parks the main subject of this proposed study.

It is widely believed that techno-science parks have unique role in transforming a nation into knowledge-based economy since its establishment align closely with the key drivers of knowledge-based economy i.e. innovation, R&D, commercialization of ideas, entrepreneurship and university-industry-government smart partnership.

This paper has been prepared to provide general understanding on the concept and development of techno-science parks particularly its development in the Malaysian context. It is not intended to provide a comprehensive analysis or assessment of techno-science parks in Malaysia. This study is primarily aimed at creating awareness on the potential role that techno-science parks can play not only in accelerating Malaysia's industrialization programmes but also in transforming the country into knowledge-based economy. This study contends that Malaysian technological parks merely succeed in accelerating the industrialization programmes but much efforts still need to be endeavored to enhance their value-added activities to make them fully eligible to enter the 'k-economy world'.

INTRODUCTION: TECHNO-SCIENCE AS A CONCEPTUAL FRAMEWORK

Modern science, as it developed from the seventeenth century to the nineteenth centuries became an essentially public cooperative activity. The nineteenth century onwards further witnesses the development of applied science to techno-science. According to Latour (1987), this it is an era where it no longer makes sense to talk of a separation between pure and applied science or between science and technology. Techno-science, as defined by Latour and Pickstone, is a product of socio-economic vision which intimately interconnects science and technology with industrial capitalism (Tiles & Oberdiek, 1995).

That is perhaps no doubt that today we find added to the total vision the ingredient of economic theory gives technology a socially progressive role because it increases productivity. That is why nowadays efficiency becomes a crucial evaluative concept.

In addition, techno-science era also witness the growing of new trend that is treating knowledge as a commodity. This could be traced back to the introduction of the system of patents, copyrights and varietal registration for seeds. The most common practice among the variety of institutions (university research, pharmaceutical company, government laboratories, and hospitals) nowadays are not primarily oriented towards advancing scientific disciplines but to the creation and sale of techno-products. As stressed by Pickstone (1993), "these linked institutions operated in markets or quasi markets. They were oriented primarily to the production of commodities which people (or governments) purchased. Characteristically, they involved the commercialization of analytical procedures (e.g. fees for testing) and the commercialization of experimental products (e.g. vaccine)"(p.238).

In short 'techno-science' signifies new trend and orientation towards fusing science and technology and to commodifying the products of both. It is part and parcel of wider nineteenth century movements to sell science to industrialists and politicians, a movement which saw scientific and technological progress as an engine / catalyst for economic and social progress (Tiles & Oberdiek, 1995, p.109).

Techno-science as defined by Picktone (2000) is "the industrial-academic-government networks that manufactured knowledge-based commodities". The growth of techno-scientific companies producing new commodities from their own research laboratories and from the web of academic and government institutions has been a major feature of twentieth century. According to Pickstone, the main attribute of techno-science are the massive involvement and interaction of various actors and the involvement of all level of knowing and making in its development i.e. natural history, analysis, experimentation and invention.

By employing this concept of techno-science, this study suggests that the most important component of techno-science parks would be the academic-industry-government networks. Aside from this, this study argues that the primary orientation of techno-science parks are not primarily oriented towards advancing scientific disciplines but to the commercialization and commodification of techno-scientific products.

In relation to this concept, Amran (2004) highlights the issue of academic patenting culture which he regards as a crucial element of modern scientific activity particularly with regard to university-industry-government relations. He also stresses a systemic relation between the sustenance of the techno-science complex and patenting activity. He is right when he stresses that "it is inconceivable for the techno-science complex to exist without patents and patent system" (p.54). This signifies patenting as the crucial characteristic for modern techno-science complex. The patent systems according to Amran is very influential in the shaping of the direction of the industrialization of inventions as well as the internationalization of inventions, two major characteristics of techno-science complex (p.69).

THE CONCEPT AND DEVELOPMENT OF TECHNO-SCIENCE PARKS: AN OVERVIEW

The development of techno-science parks is indeed the image of the twentieth century (Castells & Hall, 1994). The development of techno-science parks go under a bewildering variety of names. Among the synonyms are technopoles, technocities, science park, industrial park, technological park and so on. Although differ in term of names, they are widely viewed as strategic tools to accelerate economic growth and to transform a nation into knowledge-based economy (Kirk and Catts, 2004). This unique potential of techno-science parks is due to its

supposed features which closely align with the key drivers of today's knowledge economy i.e. development of innovation, R&D, commercialization of ideas, entrepreneurship and university-industry-government smart partnership.

Most literature on science and technological parks mainly cover the developed countries of OECD and the Newly Industrializing Economies (NIEs). It is obvious that there is a lack of evidence about the role of science and technological parks in the less developed countries. Therefore, this paper attempts to fill this academic gap by analyzing the role and contribution of techno-science parks in Malaysia.

Most literature on techno-science parks agree that science and technological parks are originally derived from the ideas of Stanford University which later on grew as successful Silicon Valley. They also agree that Silicon Valley is the first successful model for science and technological parks (Castells & Hall, 2004; Massey, Quintas & Weild, 1992; Lai & Yap, 2004; Bunnell, 2002; Ramasamy B., Chakrabarty, A. & Cheah, M., 2004). It is due to the success of Silicon Valley that most of the literature on science and technological parks focused on assessing the main ingredients for its success. For example, Castell and Hall (1994) attribute SV success to its uncompromising commitment to innovative milieu, the existence of self-support system of finance from venture capital firms within the SV itself and the excellent role played by the universities within its territory as sources of new scientific-technological knowledge and as providers of highly-skilled labours.

The International Association of Science Parks (IASP) and The UK Science Park Association (UKSPA) provide broader working definition for techno-science parks. The IASP defines a science and technology park as a property-based initiative which is designed to encourage the formation and growth of knowledge-based industries or high value added tertiary firms. Some of these parks might have operational links with universities, research centers and other institutions of higher education. Additionally, IASP emphasizes on the need of steady management team to manage the parks' activities. There is no remarkable difference between the IASP and UKSPA's definitions of Science Park.

Perhaps, the most comprehensive work on the concept, development and performance of techno-science parks all over the world could be found in the work of Manual Castells and Peter Hall (1994) who coined the term technopoles. Basically, technopoles as defined by them is "the industrial technological centre resulted from various kinds of cooperation or partnership between the public and public sectors. They are promoted by central or regional or local governments, often in association with universities, research institutes together with the private companies (Castells & Hall 1994:1). Both of them successfully identify the winning formula for successful technopoles which should include innovative milieu, the capacity to reindustrialize on the basis of advanced, competitive firms, and the ability to decentralize from traditional core locations into new and dynamic star-up regions.

Further understanding on the concept of techno-science parks could be attained from the work of Massey and colleagues (1992). They highlight that "at the core of the science park concept lies the idea that scientific knowledge leads in some linear progression to technological innovation" (Massey, Quintas & Weild 1992: 34). They add that universities are seen as repositories of scientific expertise and research, and the view is that the UK is good at basic science but bad at commercializing its fruits. Therefore, they argue that science parks are a way of orienting academe more closely to the needs of industry.

Recent contribution to the literature of techno-science parks focused mainly on the assessment of the latter's performance by examining several country case studies such as Hong Kong Science Park (Chan & Lau, 2005); Greece Science Park (Bakouros et, 2002); Singapore Science Park (Lai & Yap, 2004); Western Australian Technology Park (Phillimore, 1999) and Daeduck Science Park in Korea (Lai & Yap, 2004). Some outstanding studies on the performance of science parks in UK have been done by Gower & Harris (1994), Massey et and Carter (1989).

All of them argue that there are goods and bads in the development of techno-science parks. And they agree that the real objectives for the establishment of these parks are yet to be attained.

Significantly, the concept of techno-science has been adopted in several contexts. For example Massey and colleagues (1992) analyze techno-science park in relation to its social context and spatial distribution. Carter (1989) and Gower et. (1996) on the other hand reminds us on the importance of management aspect in techno-science development. Smart collaboration between science parks and university-industry interactions always constitutes the main theme of analysis in techno-science studies (Pickstone, 2000; Castells & Hall, 1994; Lee & Yang, 2000; Lai & Yap, 2004; Massey et.1992; Gower & Harris, 1994; Vedovello,C., 1997; Amran Muhammad, 2006). The assessment of the vital role of government particularly public funding in supporting the techno-science development is indeed the main topic of interest among scholars of techno-science studies (Pickstone, 2000; Castells & Hall, 1994; Gower & Harris, 1994). Although they acknowledge the role of government in this development, they assert that techno-science parks could not depend solely on the public funding. In this regard, they maintain the importance of smart partnership between public and private sectors for continuous vitality and dynamism of techno-science parks.

If the success of techno-science parks in USA referred mainly to Silicon Valley, the main reference for the Asian successful park will be referred to the Hsinchu Science Park in Taiwan Province of China. Interestingly, some viewed Hsinchu Science Park as the only one in the world that has successfully replicated the Silicon Valley (Lubman, 1999; Saxenian, 2000). Many studies have been conducted to assess the performance of Hsinchu Science Park (Chen & Choi , 2004; Lai & Yap, 2004; Lee & Yap, 2000). Most of the studies on the performance of Hsinchu Science Parks highlighted the uncompromising support of Taiwanese government in the techno-science development as the main ingredient for Hsinchu's success. Another important factor is the ability to create a system to convert tacit knowledge into productive process as well as a system to create knowledge itself (Chen & Choi, 2004).

There is vast literature on the performance of techno-science parks in developed countries as well as in the Newly Industrializing Economies (NIEs). On the other hand, the literature on the development of techno-science parks in less developed countries such as Malaysia is very limited. Among the important works which have significant relevance to this study is the outstanding work of Tim Bunnell (2002) entitled "Multimedia Myths and Realities: Contesting Technological Utopianism in Malaysia's Multimedia Super Corridor" which focuses on the assessment of MSC performance from the social aspect. The authors highlights that there is truth and fantasy in MSC development. One of the main social problems in relation to MSC development is the marginalization and discrimination of plantation workers.

Another remarkable work which also has significance relevance to this study is the well-written work of B.Ramasamy, A.Chakrabarty, and M.Cheah (2004). They analyze the MSC performance but from different angle specifically from an institutional and entrepreneurial perspectives.

Lai & Yap's study (2004) also contribute significantly to this study particularly their assessment on the role of science and technology parks in NIEs and Malaysia that are Daeduck Science Park (Republic of Korea), Singapore Science Park, Hsinchu Science Park(Taiwan Province of China) and Kulim Hi-Tech Park, Technology Park Malaysia and MSC of Malaysia. The authors regard those science and technology parks as one of the strategic resources that have been utilized in the course of the countries technological development together with human capital, R&D, foreign technology transfer and government research institutes (GRIs).

Another relevant work is the IRPA–funded Project headed by Nurwati Badarulzaman (1998) namely "High Technology Industrial Parks and Impact on Regional Development in Malaysia". In this study, the author highlights the potential impacts of high technology parks on regional

development particularly in terms of job creation and technology transfer. However, she argues that high technology parks' impact in term of R&D development is still very low.

This brief analysis on the techno-science literature reveals the important fact that techno-science studies are not about the economic and business ventures solely but inclusive of social aspects such as politics, socio-cultural, management and geography. Significantly, techno-science studies cannot be independent from its social context. As stressed out by Amran (2006), techno-science development should be incorporated in today's Science & Technology Studies (mainly offered at the tertiary level) particularly the one that concerned with techno-science policies and implementations.

In short, techno-science park is indeed the place of scientists, technologists and engineers in the class structure of capitalist society and how that place is changing. It is also a place where value-added activities such as scientific research and industrial innovation are expected to be conducted extensively. Apart from this, this study stresses that the development of techno-science parks is symbolic of wider changes, and of a wider politics.

THE EVOLUTION AND DEVELOPMENT OF TECHNO-SCIENCE PARKS IN MALAYSIA: AN OVERVIEW

It is important to highlight that the development of techno-science parks in Malaysia has close relationship with the development of industrialization programmes. Therefore, in order to get clear picture on the development of techno-science parks, thorough study on Malaysian economic history particularly its industrialization programmes is indeed inevitable. In this regard, this study will heavily assess the development of Malaysian economic development particularly the techno-science parks development from the First up to the Eight Malaysia Plans *(Rancangan Malaysia 1-8)* as the most viable and reliable Malaysian government's documents.

Malaysia's economic achievement is indeed very impressive. It has successfully moved from a tin, rubber and palm oil exporter at the time of its independence to the exporter of electronics and industrial goods and services. Being pragmatic, Malaysia under its successive leadership has employed various policies and strategies to secure the country's economic survival and competitiveness in an increasingly competitive and dynamic world. Malaysian government has successfully developed the country's economy particularly the industrial-manufacturing sector by employing various growth strategies ranging from import-substitution and export-led strategy to productivity-driven as well as knowledge-intensive growth strategies (Yoke & Leng (eds), 1996; Michael Yeoh, 2002; Chuan (ed), 2002; Jomo K.S, 2003; Jomo K.S. & Wah (eds), 1999; M.Bakri Musa, 2002; Okposin, Abdul Halim & Boon, 2005 & Mahathir Mohamad, 2006).. The latter constitutes Malaysia's recent strategy in order to be competitive in today's knowledge-based economy (Abdulai, 2004).

In order to succeed in today's knowledge economy and to realize its vision of becoming a developed nation by the year 2020, it must develop the requisite infrastructure and infostructure which are needed to support knowledge-based industries as well as activities related to such economy (Abdulai, 2004). One of the strategic tools for the successful transformation into knowledge economy is the development of techno-science parks (Castells & Hall (1994); Kirk & Catts (2004), the main subject of this proposed study.

From the study of Malaysian economic development, this study found that industrial development in the country since the 1960's was the main catalyst for the development of early techno-science parks. However, those techno-science complexes were operated under the names of **industrial estates / industrial parks and Free Trade Zones.** They were definitely contradicted with the framework of today's techno-science parks either in term of their conceptual or operational framework. The remarkable differences could be noticed in terms of

their objectives, scope of activities, management and level of technology used in their industrial operations.

Malaysia is the world's largest producer of both rubber and tin during its formative years, which together account for 55 per cent of the nation's exports and about 30 per cent of GNP in 1965 (RMK1). It was only with the passage of time that Malaysia realized that an acceleration of agricultural activity alone will not be sufficient to generate and maintain a high rate of income and employment growth. Therefore, Malaysia tended to rely on the growth in second industry to produce progressive increases in income and employment for a growing population (RMK1, p.123). Therefore, the government's commitment towards developing the industrial field especially the manufacturing sector became increasingly important and inevitable.

The Malaysian government played a proactive role in the 1960's to maintain a favourable investment climate and environment to attract foreign direct investment for industrial development which would simultaneously create job opportunities for its local people. Among the promotional measures in 1960's as recorded in the First Malaysia Plan was the introduction of protective tariffs, industrial credits and loans especially by Malaysian Industrial Development Finance Berhad (MIDF) and its subsidiary company, the Malaysian Industrial Estates Ltd. (MIEL) , tax relief provided to pioneer industries, exemption from import duties on the raw material imports of industrial ventures and the **establishment of industrial estates / parks** with good facilities such as water and power supply as well as communication facilities particularly in the main population centers of the country (First Malaysia Plan, p. 132 and Mahathir Mohamad, 2006).

From the analysis of the First Malaysia Plan (1966-1970), it is obvious that the government's role towards developing industrial parks and estates as support for industrialization programmes had been remarkable since the 1960's. The main concern which occupied the government attention at that time was to promote industrial activities in less developed states, thus to achieve more balanced regional industrial growth, to create jobs for its growing population and to attract foreign direct investment (FDI) by providing adequate infrastructure for their operations(Mahathir Mohamad (2006)). Among the important industrial estates established by the government to support foreign enterprises at home during the First Malaysia Plan period were; Tampoi (143 acre) and Larkin (154 acre) in Johor Baharu, Tasek (370 acre) in Ipoh, Mak Mandin (320 acre) near Butterworth, Senawang (400 acre) in Seremban, Tupai (150 acre) near Taiping, Batu Tiga (695 acre) in Klang and Kamunting (600 acre) near Taiping. It is also recorded that the first Malaysia's industrial estate which was a successful is at Petaling Jaya, Selangor (First Malaysia Plan, p.126).

From the analysis of Second and Third Malaysia Plan which dominantly covered the period of the 1970's, the promotion of export-oriented strategy (particularly the exports of manufactured goods) by the government resulted in the increased importance of industrial estates and **Free Trade Zones (FTZs)**, to accelerate the export growth through the increase in foreign investment. In addition, the introduction of Investment Incentives Act 1968 (which replaced the Pioneer Industries Ordinance 0f 1958), further increased the role of FTZs in supporting the export-oriented industries.

Significantly, FTZs were established to cater for export-oriented companies therefore, the main investments derived primarily from the multi-national electronic firms in the country. It is reported that FTZ gave impetus for the rise of electronic and electrical machinery industries and the growth of manufactured products (Third Malaysia Plan, p.312). Exports of electronics and electrical components increased sharply during 1971-1975. These were largely from international concerns located in the Free Trade Zones established in 1972-1973 (Third Malaysia Plan, p.312).

It is also recorded that FTZs was actually the product of the Federal and State government collaborations mainly through their respective agencies namely Federal Industrial Development

Authority (FIDA) and State Economic Development Corporations (SEDCs) in order to expand industrial development. The cooperation of FIDA in this role will result in the industrial estates being more suitably designed for needs of investors. Government funds were channeled to the SEDCs for the establishment of industrial estates and FTZs. The State governments had to develop properly the existing as well as new industrial zones and FTZs in their localities such as ensuring the provision of adequate water and power supplies and more efficient transport and telecommunications facilities. These free and trade zones played a major role in industrial expansion. Over two-thirds of the expansion in non-traditional manufactured exports and about one-third of the employment created by the manufacturing sector originated from FTZs. (Third Malaysia Plan, p.272). Direct foreign investment also contributed towards technological progress, initially bringing technology in a package consisting of new techniques, capital, marketing and management skills (Fourth Malaysia Plan, p. 136). It is assumed that industrial estates and FTZs also played remarkable roles to diffuse technology transfer and know-how.

The issues of productivity, competitiveness and efficiency in the 1980's did affect the development of techno-science parks in Malaysia. Despite of traditional functions of FTZ which was mainly assembly-type of operations, low-mechanization and labour-intensive, the establishment of techno-science parks in the second half of 1980's in Malaysia is expected to play a more productive and higher value-added activities. Moreover, from the second half of the 1980's onwards, the Malaysian government also undertook more aggressive attitude towards accelerating the science and technology as well as industrial development which could be well manifested with the launching of the National Science and technology Policy in 1986 and the Industrial Master Plan (IMP) in 1983 at home as a strategic mean to enhance the country's comparative advantage and to sustain economic growth. Empowerment of the private sector role to stimulate R&D and innovation was further emphasized during this period (Fifth Malaysia Plan, p. 27). It is expected that R&D at this stage will be focused towards production processes and product development in order to achieve higher level of manufacturing.

The productivity-driven strategy during the1980's onwards, which emphasizes on efficiency, competitiveness, innovativeness especially through R&D, innovation, science and technology development had propelled Malaysia to modernize and upgrade the concept and roles industrial estates and FTZs. Moreover, Malaysia was convinced with the successful experiences of science and technology parks in industrialized nations as well as the NIE's in generating economic growth particularly through R&D and innovation.

It was in the above context, that the government initiated an idea and a planning to establish the first technology park in Malaysia in a more modern version in order to enhance Malaysia's competitiveness and the quality of its products in the world market. With regard to the development of modern techno-science parks in Malaysia, **Seminar on Technology Park** which was held in March 16-18, 1987, in Kuala Lumpur, was indeed the government's vital initiative towards establishing modern techno-science complex in the country. This significant seminar led to the establishment of the first techno-science park in Malaysia namely **Technology Park Malaysia (TPM)** in Bukit Jalil, Kuala Lumpur.

This park was organized by the National Council for Scientific Research and Development (MPKSN) purposely to discuss about the national technology park project and to examine the relevance of technology parks in relation to our industrial development. This seminar outlined the supposed objectives, ingredients, and activities of technology park Malaysia. The project has been approved under the Fifth Malaysia Plan.

In the keynote address, Tan Sri Salehuddin Mohamed, Chief Secretary to the Government and Chairman of National Council for Scientific Research and Development highlights that the establishment of technology park signifies the government's seriousness in its efforts to spearhead the industrialization programme through the development and advancement of science and technology, and research and development (R&D). It is also expected that the proposed technology park will help to overcome all major flaws in Malaysian industrial

structure particularly manufacturing sector such as low R&D activities, and inactive involvement of private sectors in R&D ventures (Salehuddin, 1987).

Considering the prevailing conditions of Malaysian industrial environment, the Chairman emphasized that the proposed technology park should able to help promote interaction between the university and industry, private sector participation in R&D ventures, transfer of technology, extensive use of S&T and development of entrepreneurship and knowledge-based industries.

The second half of the 1990's witnessed the rapid advancement of IT and information age thus gave rise to the emergence of IT industry. Realizing the strategic role of ICT in accelerating the economic growth by increasing the efficiency and productivity, the government therefore, places greater emphasis on its development. It is obvious that IT development has gained importance and exclusivity since the Seventh Malaysia Plan (1996-2000). The rapid development of ICT worldwide has propelled the government to establish **Multimedia Super Corridor (MSC)** the most prominent techno-science park in Malaysia, in order to ensure proper implementation for ICT-related programmes, to enhance the development of IT industries and to expand IT usage among Malaysians. In this context, TPM role becomes increasingly important since it has been regarded as one of the five cybercities being developed in the MSC together with Cyberjaya, UPM-MTDC, Petronas Twin Towers and KL Tower.

The manufacturing sector as it moves to shift towards knowledge-capital-and technology-intensive industries, the application of IT in its production and marketing processes seems to be inevitable. Therefore, the Malaysian government placed greater emphasis on IT development in the 1990's. It is in the context of this new development that further enhanced the role of techno-science complexes in Malaysia such as MSC and Technology Park Malaysia as well as KHTP to further strengthen their research and technological capabilities particularly to integrate IT into the production process and the use of robotics and CAD/CAM to help manufacturers boost production, reduce costs and ensure the quality of products (Seventh Malaysia Plan, p.461).

In line with the government's diversification of the Malaysian industrial structure, the requirement of industries for industrial infrastructure and supporting services become more specialized. It is with this regard that we could note further efforts are given to the development of techno-science complexes as reported in the Seventh Malaysia Plan. This Plan approved the extension of Phase II and III of KHTP; the Subang Industrial Aerospace Park in Selangor (development of aero-space related services); the Composite Technology City in Melaka (production of composite-based products); the Natural Resources Park in Kuching, Sarawak (development in the field of natural resources and biotechnology); and the Automotive Town in Tanjong Malim, Perak (development of automotive industry and inter-firm linkages amongst assemblers and component manufacturers) (Seventh Malaysia Plan, p.298). It is obvious that the later techno-science parks tend to be more specialized in their functions.

The increasing importance of high-technology industries in Malaysia, particularly in electrical and electronics industry led to the establishment of the first comprehensive high-technology park known as **Kulim High-Technology Park, (KHTP) in Kedah**. In the second half of the 1990's, KHTP is expected to fulfill one of the strategies of the Seventh Plan that is to develop local electronic parts and components as well as the promotion of backward integration of the semiconductor industry through the establishment of wafer fabrication plants in order to minimize the dependence on imported components (Seventh Malaysia Plan, p.289). Wafer fabrication is actually the main activity of KHTP. It is of strategic importance in the country's industrialization drive as it is a core technology of the semiconductor industry. The establishment of wafer fabrication plants is expected to promote the development of high technology in Malaysia. In addition, with increasing globalization, strategic alliances with overseas companies in capital intensive and high technology industries are vigorously promoted by the government. Consequently, it significantly increases the role of KHTP in Malaysia.

government to ensure that all techno-science parks in Malaysia with give high priority to the development of value added or knowledge based activities to maintain Malaysia competitiveness in the knowledge-based economy.

CONCLUSION

The dynamics of the following factors will be regarded as the critical components in the development of 'techno-science' parks in its real sense:

1. Massive involvement of various social actors in its development particularly among the most important stakeholders i.e. government-industry-academia networks.
2. Complex mix of reinforcing socio-economic factors in the establishment and development of techno-science parks.
3. Extensive value-added activities conducted inside the parks i.e. patenting, innovation, technology transfer etc.

From the Malaysian vantage point, the development of techno-science parks in Malaysia could be viewed as strategic mechanisms utilize by the government to accelerate the country's industrialization programmes. The development of techno-science parks in Malaysia has undergone 2 phases of development. The first phase which mainly covers the period of 1960's to the first half of 1980's characterized by the development of industrial parks and Free Trade Zones. The main features of this type of techno-science parks are as follows:

- ❖ To provide infrastructure and facilities for manufacturing operations
- ❖ Emphasis on assembly-type of operations, low-level manufacturing operations, labour-intensive process and low-mechanization.
- ❖ To support export-led growth strategy
- ❖ Foreign-private domination (MNCs)
- ❖ Main industrial activities; assembling and manufacturing
- ❖ Main sub sectors; electronic and electrical sub sectors
- ❖ Collaboration between Federal and State government mainly through Malaysian Industrial Development Authority (MIDA) and State Development Corporations (SEDCs)
- ❖ In term of management it was an isolated and remote from national agenda

The second phase which begins in the second half of 1980's up to the new millennium dominated by new version of techno-science development which characterized by the following features:

- To provide infrastructure and facilities particularly for R&D development
- To cater for knowledge-intensive industries with extensive application of high technology in industrial activities.
- To accelerate productivity-driven and knowledge-intensive growth strategies.
- Focus more on knowledge-based activities like R&D, innovation, product development, technology transfer, commercialization and patenting.
- Emphasis not only on electrical &electronic sub sector, but inclusive of new emerging and more promising technologies i.e. biotechnology, advanced materials, macroelectronis, ICT, aerospace etc.
- Active collaborations between public and private sector including higher learning and research institutions.
- Managed mainly by privatized corporations such as Kulim Technology Park Corporation and Technology Park Malaysia Corporation Sdn. Bhd.
- Become more institutionalized which meant that it has become part and parcel of national agenda.

Despite of their glaring differences in term of specialization, management and operations, they share certain commonalities particularly in term of the objectives of establishment i.e. to create

The prospects for the growth during the Eight Malaysia Plan (2001-2005), i.e. the first five years of the new millennium, have to take into consideration the challenges arising from a more liberalized global economy and rapid technological transformation. Greater efforts, therefore, have to be undertaken by the government to ensure the sustainability and resilience of economy in the long term to attain the targets of the Vision 2020. As the globe is entering the new millennium, vigorous efforts towards developing the knowledge-based economy are being vigorously undertaken by all nations including Malaysia. It is thus, in cognizant with the government efforts, the roles of techno-science complexes will further intensify particularly in enhancing research and innovation activities, the introduction and upgrading of technology, commercialization of ideas, and smart partnership between industry-government-university.

In the new millennium, the electrical and electronic products sub sector is expected to shift towards higher technology and value-added activities through skills upgrading, product design and R&D. To enhance indigenous capability in the electronics industry, efforts were taken to expand and upgrade the semiconductor technology programme which involved R&D and training in wafer fabrication and integrated circuit design (RMK8, p.345). Further development and expansion of wafer fabrication projects has been accorded in the Eight Malaysia Plan, which implies the increasing role of KHTP as techno-science park (p.42).

Global trends indicate that innovation in biotechnology is one of the key technologies for the 21st century. Recognizing this new development, Malaysia undertakes vigorous efforts to build up its R&D base to harness the use of biotechnology in order to create value from the nation's megabiodiversity of natural resources. The new development resulted to the increasing role of Malaysian techno-science particularly TPM to contribute towards biotechnology development (Symbiosis, October, 2001 and June 2003).

In order to accelerate private participation in the development of industrial research and indigenous technological capabilities, various research schemes and grants were introduced by the government such as the Industrial Research and Development Grant Scheme (IGS) since 1997; the Demonstrator Applications Grant Scheme (DAGS) launched in 1998; the Commercialization of Research and Development Fund (CRDF) and Technology Acquisition Fund (TAF) both were launched in 1997 also. To promote R&D activities in MSC such as to create innovative multimedia products, processes and services the MSC Research and Development Grant (MGS) was launched in 1998.

Foreign investors are also encouraged to forge strategic alliances with local SMEs. Since 1990's onwards, the government's efforts to intensify the role of SMEs in supporting national industrialization efforts through forging linkages across the manufacturing sector are indeed commendable. In this regard, techno-science complexes in Malaysia such as TPM and MIMOS Berhad are expected to contribute extensively particularly in providing technical assistance programmes to strengthen technological capability of the SMEs. One of the important supporting services is the presence of incubator facilities to assist in the development of a new breed of technology-based SMEs (Eight Malaysia Plan, p.359). Technology incubator centers for instance were set up by TPM and MTDC to nurture and develop high-technology start-up companies. By the end of the Seventh Malaysia Plan, a total of 79 technology-based start-up companies were in TPM while another 53 companies were located in the MTDC (RMK8, p.248). These companies are involved in activities related to bio-technology, multimedia and ICT, advanced electronics and software development. Facilities to increase R&D in advanced materials manufacturing and microelectronics was also expanded in line with IMP2. With this regard, the Advanced Materials Research Center in KHTP provides all facilities required such as photonics, composites and nano materials which will contribute towards developing the automotive, electronics, telecommunications, aerospace and health industries (RMK8, p.260).

Realizing the realities of a rapidly changing global economy which is innovation-and-technology driven the Malaysian government has to be pragmatic and proactive in order to ensure the country's economic resilience and competitiveness. It is therefore imperative for the

job and to spearhead industrialization programmes. Both are essentially regarded as economic development tools provided by the government to facilitate private sector participation in industrial activities particularly to attract the foreign investors. Another remarkable similarity was that they involved massive organizations in their establishment and operations which commonly include; the federal and state governments mainly the SEDCs, the private sectors such as foreign-private enterprises and MNCs, public sector agencies and research institutions, industries as well as the universities. The linkages with the last two are indeed the recent phenomena. It is in this regard that is massive involvement of various stakeholders that has significance relevance with Pickstone's concept of technoscience. It is only in terms of the "ways of making" that Malaysia techno-science complexes need to be further enhanced.

This study also suggests that the role of the Malaysian government in the development of techno-science parks was largely motivated by pragmatic considerations. Significantly, if Malaysia is to move to a knowledge-based economy it must first succeed in developing the necessary physical infrastructure which is vital to support knowledge-based industries development. In this regard, Malaysia efforts to develop the techno-science parks are indeed one of its correct strategies and perhaps timely efforts since the latter are commonly regarded as the strategic tools to accelerate the development of knowledge economy. However, physical development of the techno-science parks alone is not enough to realize the dream. It must be combined with aggressive efforts to enhance the "contents of the parks". This signifies that for knowledge-based industries to succeed it must combine with higher value added or knowledge based activities at more aggressive manner. This includes the strategies to further develop R&D and innovation, indigenous technology and technology transfer, knowledge-workers, public-private smart partnership at home, regionally as well as globally, international publications and Intellectual Property Rights. Indeed, the techno-science parks can contribute towards achieving all the strategies with all their unique roles.

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